

In-house Retro-Commissioning

Optimizing Existing Buildings Energy for Efficiency

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.



Introduction

- **Overview of Retro-Commissioning (Retro-Cx)**
- **History**
- **Criteria**
- **Process**
- **Building Specific Opportunities and Implementation**



Types of Retro-Cx

- **Energy Reduction**
 - Find and fix energy inefficiencies
- **Customer Needs**
 - Adapt the building to the need of the customer
- **Reliability**
 - Ensure equipment is maintained properly
 - High Downtime Costs



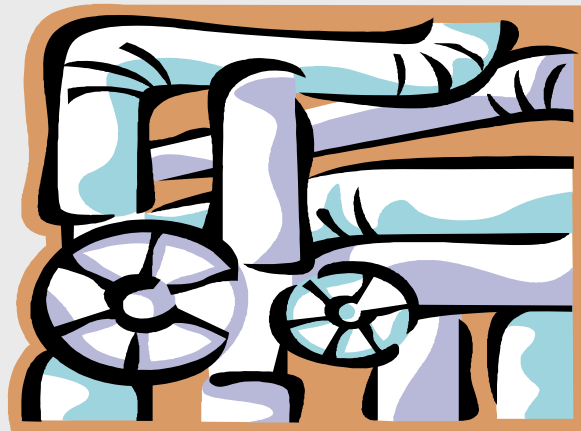
Retro-Cx Goal is to Save Energy

- **Identify and resolve operating problems**
- **Improve comfort**
- **Optimize energy to meet “current” building requirements**
- **Reduce energy to meet DOE mandated energy reduction goals**
- **Future costs of electricity will double at Sandia National Laboratories New Mexico (SNL/NM) in 2009**



Big Energy Users in Buildings

- **HVAC accounts for 40-60% of the energy used in U.S. commercial and residential buildings**
 - **Source - U.S. Department of Energy**



History

Retro-Cx at SNL/ NM



History of Retro-Cx at Sandia-NM

- **Third Party Retro-Cx (*April 2006*)**
 - In-house staff had to support third party (escort, educate them on the building automation system, union issues with maintenance)
- **New Construction at all time high (822,781 square feet in past three years)**
 - No time for in-house Retro-Cx



History of Retro-Cx at SNL/ NM

- **During the construction boom, in-house Retro-Cx pilots of existing buildings were conducted**
 - **6585 (*Technology Support Center Office and Light Laboratory*)**
 - Operational problems, change in functionality of the building (lab to office)
 - **PETL (*Processing and Environmental Technology Lab*)**
 - Tribal knowledge – high airflows in labs per design – airflows could be reduced and meet standard ratings for labs to save energy, the exhaust system was running at full capacity (detected on Facilities Control System (FCS))



Building Criteria

The Selection Process

Criteria Spreadsheet

Retro Rank	Bldg	FCS Control	Btu/GSF per year FY07	Building GSF	Building Type	Mission Critical Concerns
1	802	Hybrid	66,972.82	161,246	OFFICE	Not Mission Dependent
2	890	Hybrid	111,888.51	147,438	OFFICE/L.LAB	Mission Dependent
3	962	Hybrid	104,631.25	151,472	OFFICE/L.LAB	Mission Dependent
4	897	Total Control	104,713.09	144,125	OFFICE/L.LAB	Mission Dependent
5	701	Total Control	139,860.76	151,026	OFFICE/H.LAB	Mission Dependent
6	880	Hybrid	187,803,589.37	206,729	OFFICE/DATA CENTER	Mission Dependent
7	821	Total Control	96,413.98	85,594	OFFICE/L.LAB	Mission Dependent
8	823	Hybrid	84,710.21	145,321	OFFICE/L.LAB	Mission Dependent

Criteria Spreadsheet

Retro Rank	Bldg	Availability Gas, Elec.	Special Considerations	Maximo Tickets (Hot/Cold)	Customer Support	Building Age (Since last major Renovation)	Grand Total
1	802	E, NoGas	UPGRADED DIGITAL VAV	104		57	185
2	890	E, NoGas	24-7 OPERATION/HUMIDITY CONSIDERATIONS	40		19	173
3	962	E, G		15		19	168
4	897	E, NoGas	UPGRADED FROM STEAM TO BOILER	36		13	168
5	701	E, G	24-7	27	YES	7	168
6	880	E, NoGas	24-7 OFFICE FAN, 24-7 DATA CENTER	49	YES	55	166
7	821	E, NoGas	UPGRADED FROM STEAM TO BOILER	57		27	165

Most Important in Retro-Cx Criteria

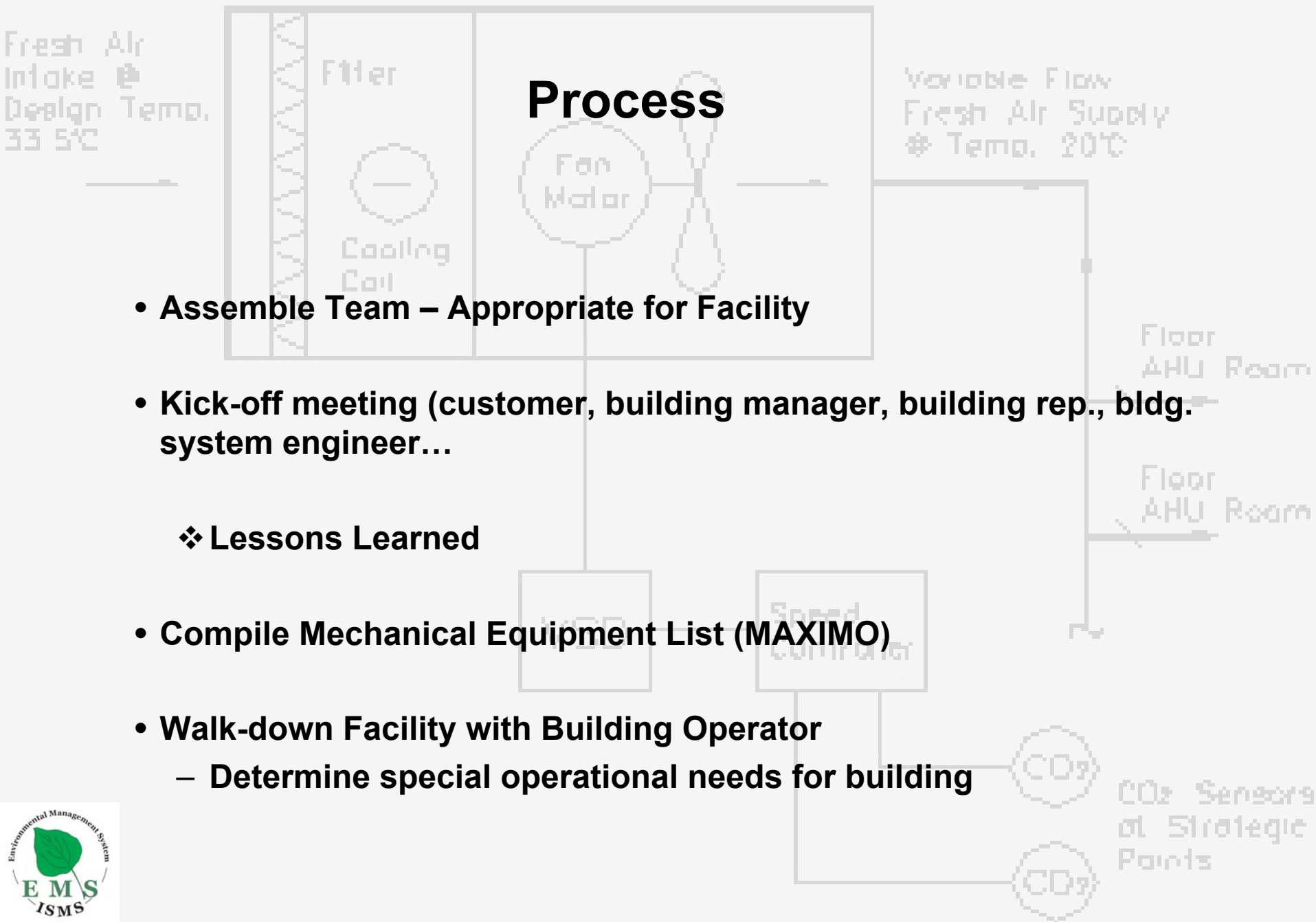
- **Building energy intensity – British Thermal Units/ Gross Square Foot (BTU/GSF)**
- **Building GSF**
- **Customer Support**



In-House Retro-Cx Process

Important Steps

Primary Air-handling Unit



- Assemble Team – Appropriate for Facility
- Kick-off meeting (customer, building manager, building rep., bldg. system engineer...

❖ Lessons Learned

- Compile Mechanical Equipment List (MAXIMO)
- Walk-down Facility with Building Operator
 - Determine special operational needs for building

Process (continued)

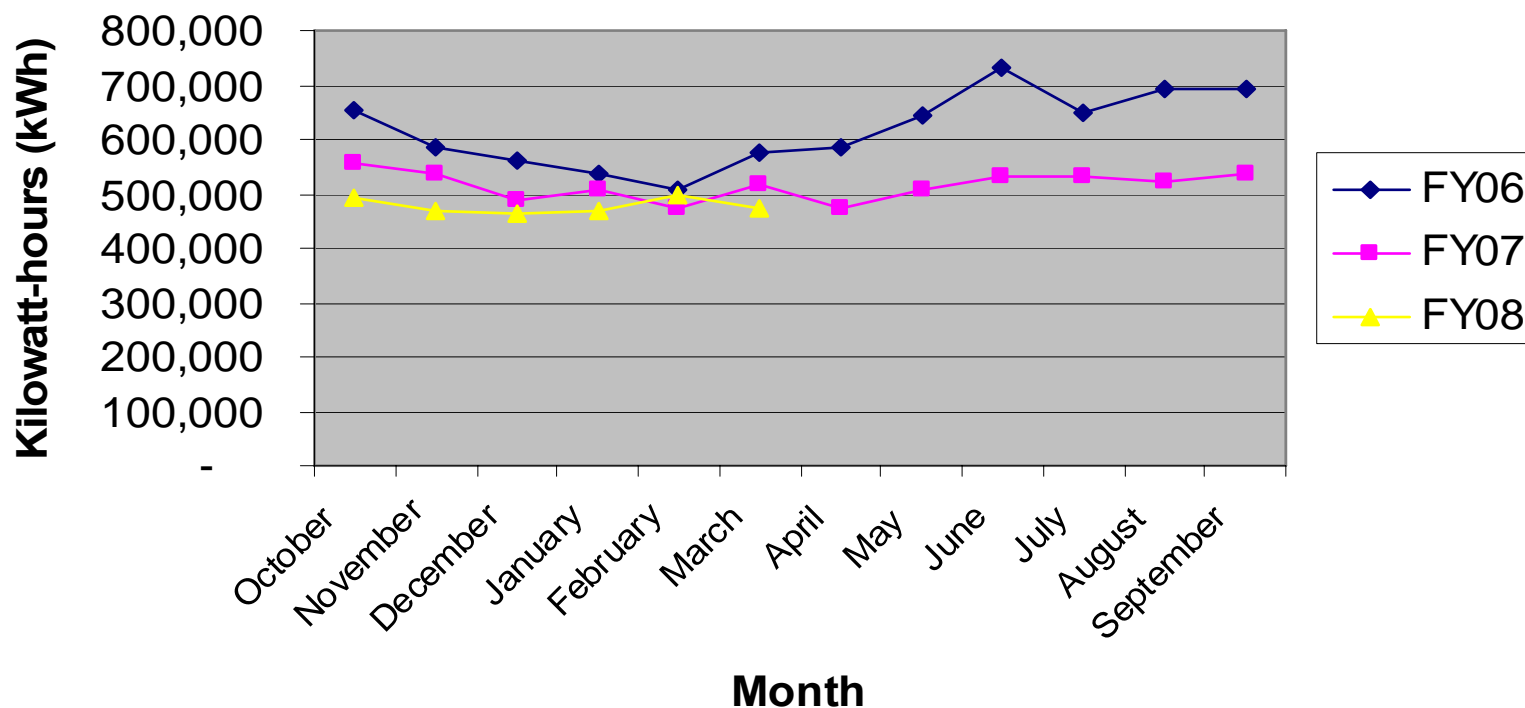
- **Building Survey**
- **Compile Deficiencies List**
 - Verification of proper operation of components
- **Trend/Monitor Energy Consumption Data and Customer Satisfaction**
- **Repair or replace any non-operational components (Maintenance)**
- **Verify Facilities Control System (FCS) Programming of Heating Ventilation and Air Conditioning (HVAC) System**
 - Meets “current” building requirements

Pilot Retro-Cx Projects

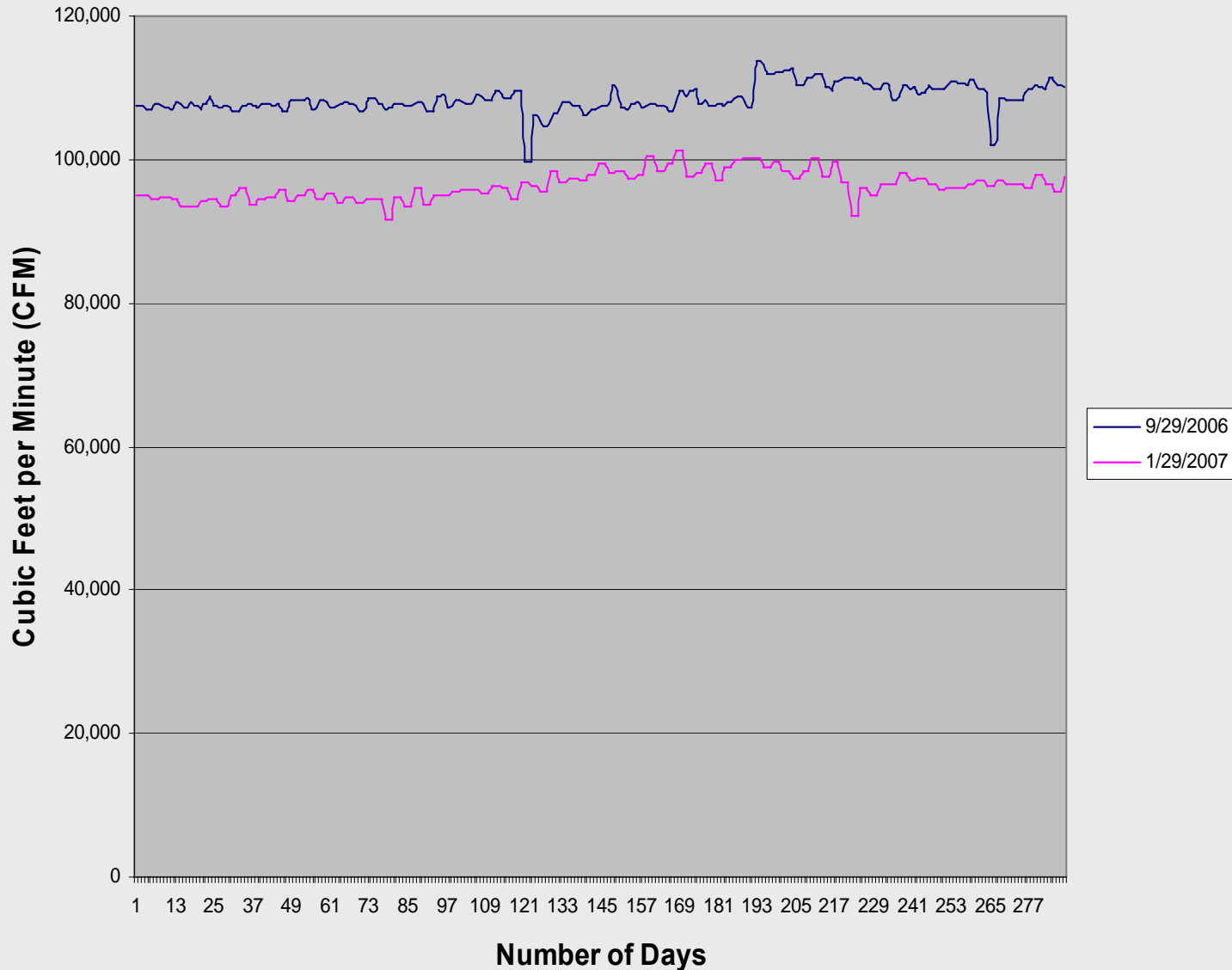
701 & 6585

Load Profiles of PETL

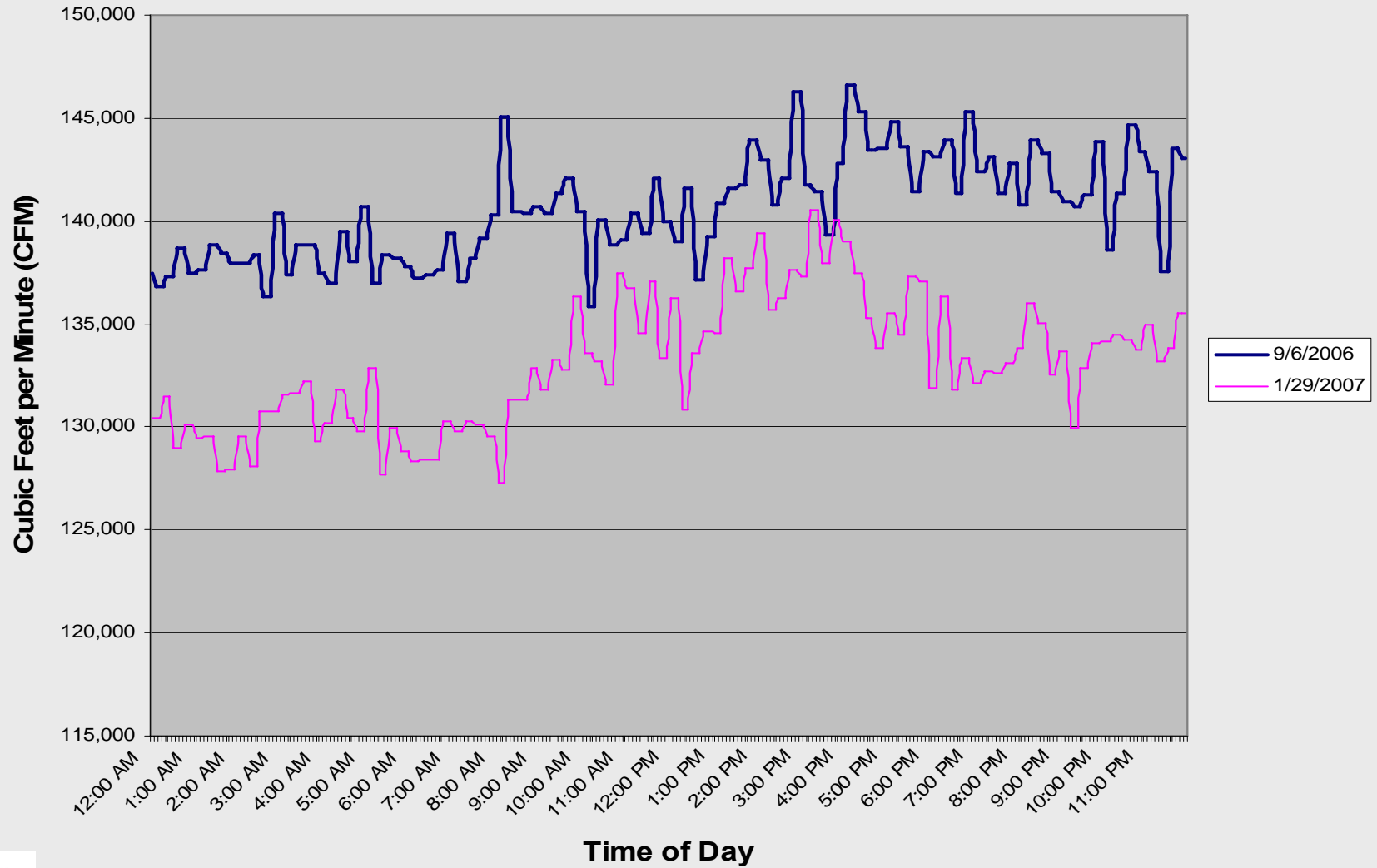
Building 701 Retro-Cx Results



BLDG 701 Lab Makeup Airflow

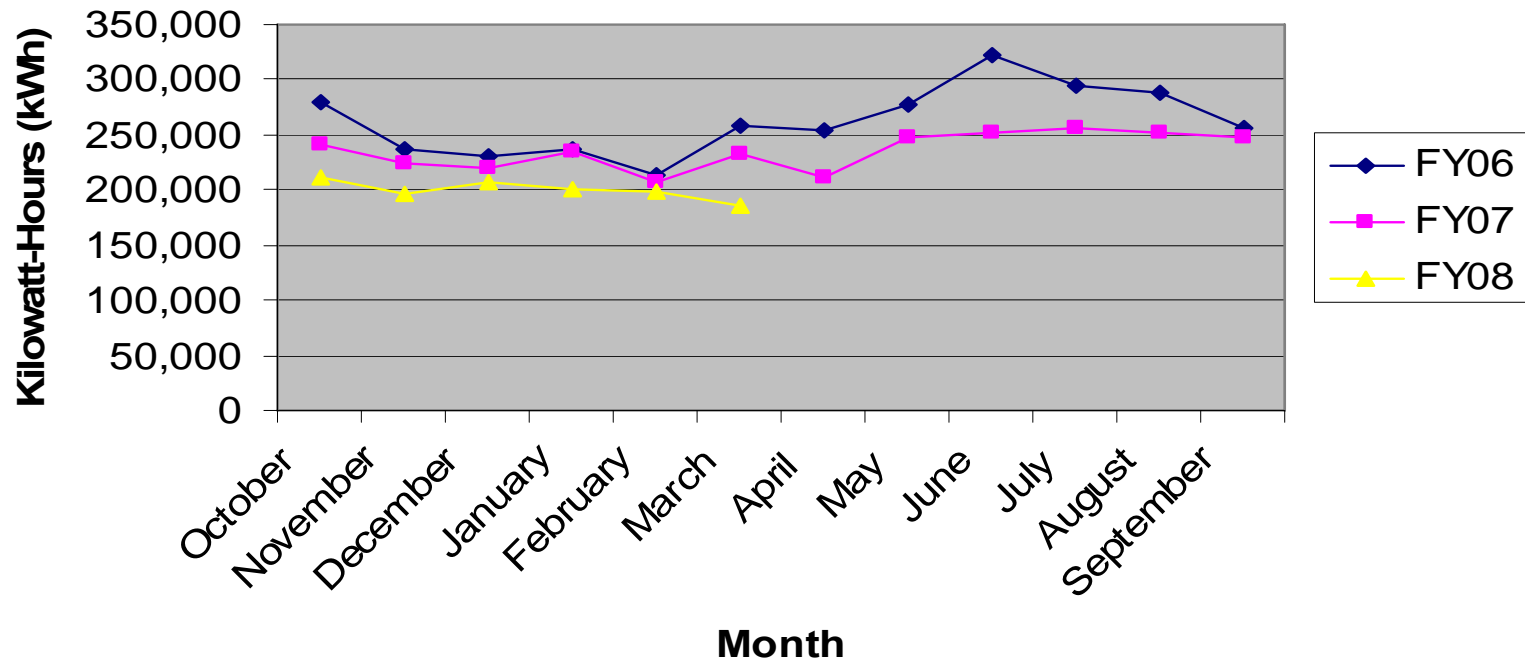


BLDG 701 Exhaust CFM



6585 Load Profile

6585 Retro-Cx Results



Annual Energy and Cost Savings

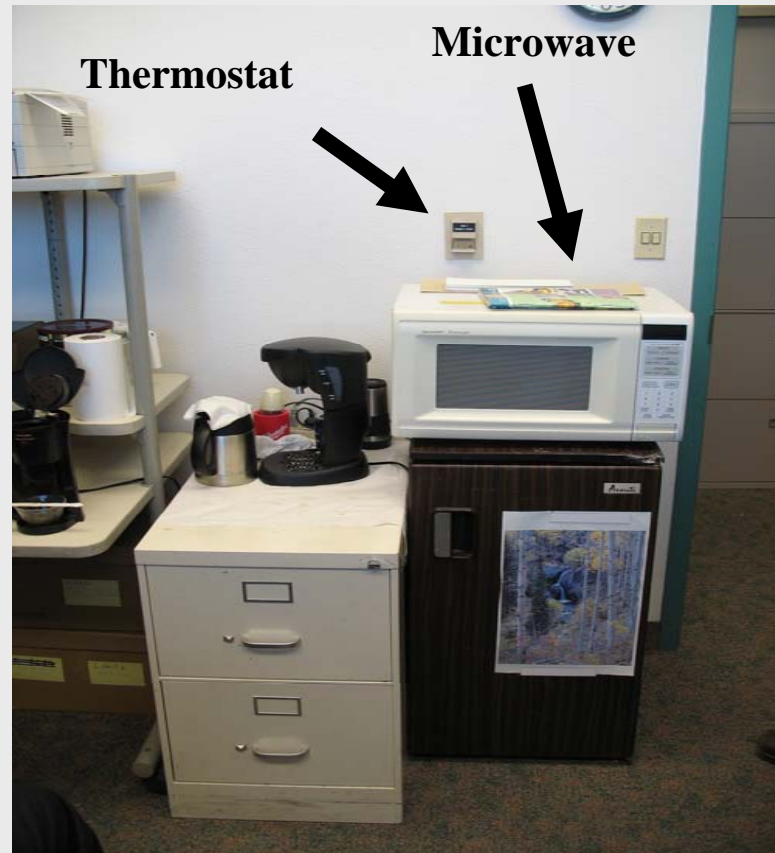
- **Building 701:**

- 1,341,920 kWh
- FY08: \$53,500
- FY09: \$107,000
- 1342 tons of carbon dioxide emissions avoided

- **Building 6585**

- 452,888 kWh
- \$ 18,115
- FY09: \$36,230
- 453 tons of carbon dioxide emissions avoided

Interesting Findings



Building 880

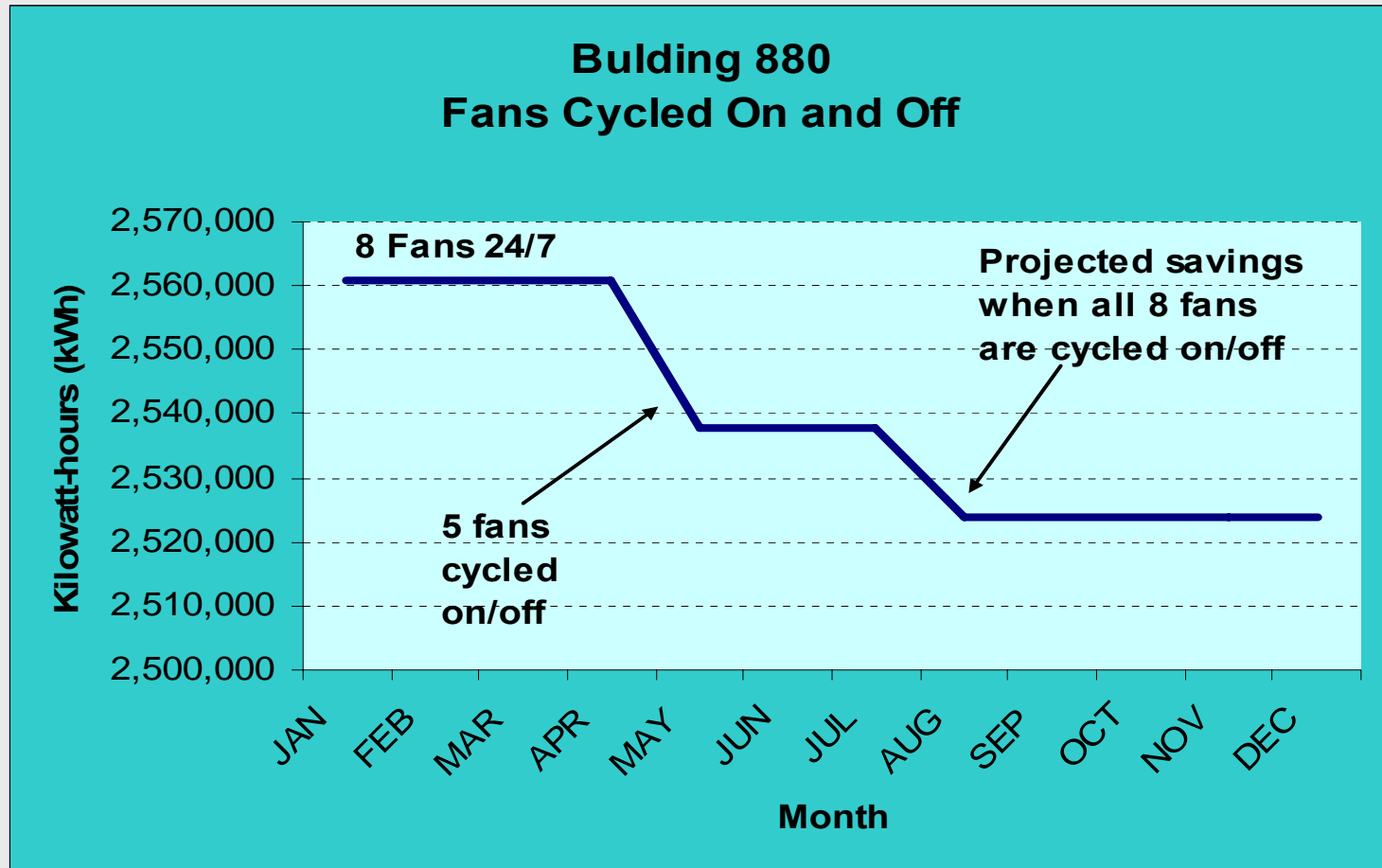
Current Retro-Cx Project

880 Retro-Cx Process

- **Building Description – Started off as a warehouse (1953)**
 - 153, 530 Gross Square Feet
- **Obvious Fixes**
 - Office Fans operating 24 hours/ 7 days a week
 - Economizer Fans 1-8 non-operation (building static problems)
 - 880 Annex - ΔT issues – Cold side Control of CRAC Units
- **Tribal Knowledge**
- **FCS - Findings**

Building 880

Initial Retro-Cx Results



Conclusion

- **In-house Retro - Cx is a good Return on Investment (ROI)**
- **Previous projects had a payback of less than one year**
- **Improved Occupant Comfort**
- **Reduced energy consumption**
- **ROI will be shorter as the cost of energy increases**